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ENGLISH STRESSES AND CHINESE TONES IN CHINESE SENTENCES.

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CHINESE SPEAKERS IN THE UNITED STATES USUALLY SPEAK CHINESE WITH ENGLISH WORDS INSERTED. IN MANDARIN CHINESE, A TONE-SANDHI RULE CHANGES A THIRD TONE PRECEDING ANOTHER THIRD TONE TO A SECOND TONE. THE THIRD TONE IS LOW--THE THREE OTHER TONES ARE HIGH. IT IS THE (-HIGH) FEATURE THAT PROVOKES CHINESE TONE SANDHI. USING THE TONE-SANDHI RULE, THE AUTHOR DESIGNED THIS EXPERIMENT TO FIND OUT HOW ENGLISH STRESSES ARE INTERPRETED IN CHINESE SENTENCES. TWO KINDS OF CHINESE SENTENCES WERE CONSTRUCTED FOR FIFTEEN SUBJECTS TO READ--IN TYPE A, CHINESE THIRD-TONE WORDS PRECEDE ENGLISH WORDS WITH DIFFERENT STRESSES ON THE FIRST SYLLABLE. IN TYPE B, ENGLISH WORDS WITH DIFFERENT STRESSES ON THE LAST SYLLABLE PRECEDE CHINESE THIRD-TONE WORDS. THE RESULTS ARE VERY NEAT--ONLY THE ENGLISH WEAKEST STRESS CAUSES THE PRECEDING CHINESE THIRD-TONE WORDS TO UNDERGO TONE SANDHI. THE ENGLISH PRIMARY, SECONDARY, AND TERTIARY STRESSES ARE INTERPRETED AS HAVING A (PLUS HIGH) FEATURE, WHILE THE WEAKEST STRESS IS REGARDED AS (-HIGH). IT IS THE INTERPRETED (-HIGH) FEATURE THAT ALLOWS THE CHINESE TONE-SANDHI RULE TO APPLY. (AUTHOR/AMM)

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~~Introduction~~ ~~i-iii~~
~~Report of the Phonology Laboratory: May, 1967~~ ~~M1-7~~
~~Report of the Phonology Laboratory: August, 1967~~ ~~A1-4~~
Chin-chuan Cheng. English stresses and Chinese tones in Chinese sentences 1-20
~~Burckhard Mohr and William S-Y. Wang. Perceptual distance and the specification of phonological features~~ ~~1-33~~
~~Marilyn May Vihman. Palatalization in Russian and Estonian~~ ~~V1-32~~

AL 000 959

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English Stresses and Chinese Tones in Chinese Sentences*

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ABSTRACT

Chinese speakers in the United States usually speak Chinese with English words inserted. In Mandarin Chinese, a tone-sandhi rule changes a third tone preceding another third tone to a second tone. The third tone is low; the three other tones are high. It is the [-high] feature that provokes Chinese tone sandhi. Using the tone-sandhi rule, we designed this experiment to find out how English stresses are interpreted in Chinese sentences. Two kinds of Chinese sentences were constructed for fifteen subjects to read: in type A, Chinese third-tone words precede English words with different stresses on the first syllable; in type B, English words with different stresses on the last syllable precede Chinese third-tone words. The results are very neat: only the English weakest stress causes the preceding Chinese third-tone words to undergo tone sandhi. The English primary, secondary, and tertiary stresses are interpreted as having a [+high] feature, while the weakest stress is regarded as [-high]. It is the interpreted [-high] feature that allows the Chinese tone-sandhi rule to apply.

PROBLEM

The goal of this experiment is to see how English stresses are interpreted by Chinese speakers when they speak Chinese with English words inserted.

Among the Chinese sentences spoken by Chinese speakers, especially Chinese students in this country, some are uttered with English words. For example:

Hǎo professor bu duō.
There are not many good professors.
Wǒ de apartment lí xuéxiào wǔ ge block.
My apartment is five blocks from campus.

Here the English words 'professor', 'apartment', and 'block' are used in or "borrowed" into the Chinese sentences. In some cases where a sentence is full of English words, we still recognize it as a Chinese sentence by virtue of its Chinese structure. This kind of borrowing is different from that which is due to lack of certain words in a language. The speakers are "bilinguals" of Chinese and English, although the degree of English proficiency varies from individual to individual. They do not borrow English words into their language system; rather, they use English words directly. Most of the English words borrowed as a result of the speaker's knowledge of English are not established in the Chinese language. It is an interference in the speech of bilinguals, not in the language as a system. In my examples, there are Chinese words for 'professor' (jiào shòu), 'apartment' (gōng yù), and 'block' (jiē). But in an English community, Chinese speakers are to some degree "dominated" by the English language; hence, they use English words frequently. When they speak to people they don't know well, however, they always reduce English words to a minimum: technical terms which are not yet translated and proper names which are not yet conventionally transliterated are inevitable in conversations.

It is generally assumed that borrowed foreign words are more or less adjusted to the phonetic and morphological systems of the native language:

with speakers who are not familiar with the language from which the words are borrowed there will be a tendency to adjust the loans to their native patterns, whereas those who know the source language will tend to keep the original forms. A bilingual Chinese speaker may pronounce English stresses in the same way as a native speaker of English; at the same time, because of their common prosodic characteristics he may equate them in his mind with Chinese tones.

Earlier, Chomsky, Halle, and Lukoff (1956) tried to establish the predictability of stress from "accent". Doubts about the phonemic status of stress in English were also expressed in Wang (1962). It is now understood, as briefly stated in Chomsky and Miller (1963), that in the underlying representations of English phonology, there is no stress. In the phonetic realization, however, there exist at least four degrees of stress: primary, secondary, tertiary, and weakest. They are marked 1, 2, 3, and 4 above the syllables in this paper. For example:

1 3 4 1 4
content, professor

In Mandarin Chinese there are four basic tones and a neutral tone, which can be derived from the four underlying tones with the aid of syntactic structures and certain markings in the lexicon. The first tone, high level, starts near the top of a speaker's pitch range and continues on that level to the end. This is marked by - over the vowel, or main vowel in the case of diphthongs. The second tone, high rising, marked by ˊ , starts at mid-range and rises to the top of the range. The third tone, low dipping or falling and rising, ˇ , starts below mid-range, dips to the lowest pitch, and rises above mid-range. The fourth tone, high falling, ˋ , starts near the top of the range and falls toward the bottom. This traditional understanding of Mandarin tones, as seen in Chao (1948), is confirmed by acoustic measurings carried out by Brotzman (1963) and Dreher and Lee (1966).

English stresses are related not to individual morphemes, but to the way the morphemes are arranged in larger units of structure. In Chinese, the tone or relative pitch with which a word is pronounced is essential to the lexical meaning of the word itself. For example, the syllable 'ma' with different

tones:

mā	mother
má	hemp
mǎ	horse
mà	to scold

The third tone has its full contour only when it is in citation or at the end of a certain construction, which indicates a real or potential pause; before any other tone except another third tone, it is pronounced as a low tone without the final rise in pitch. If two third-tone syllables occur in an uninterrupted succession, the first changes to a second tone. Thus 'mǎi' ("to buy") plus 'mǎ' ("horse") becomes 'mái mǎ' ("to buy a horse"). The alternation of tones is called tone sandhi. The experiments which were carried out by Shen, Chao, and Peterson (1961) and Wang and Li (1967) prove that the second tone derived from the original third tone cannot be distinguished from the original second tone. Thus 'mái mǎ' (from 'mǎi mǎ', "to buy a horse") is indistinguishable from 'mái mǎ' ("to bury a horse").

'Hao' ("good") is a third-tone word. In the example 'Hǎo professor bu duō', does this third tone change to a second when it precedes the English word 'professor'? That is what we want to find out in this study. Do a Chinese third tone preceding different English stresses and different English stresses preceding a Chinese third tone undergo tone sandhi? If so, how?

If any English stress causes Chinese tone sandhi or if a Chinese third tone causes the preceding English stress to become a rising pitch, i.e. a Chinese second tone, then we can be sure that English stresses are interpreted somehow in the same way as Chinese tones in Chinese sentences.

METHOD

SUBJECTS

In the spring of 1966, we selected as our speakers fifteen Chinese students (thirteen graduate and two undergraduate) in various fields at the University of Illinois. The ages of the subjects ranged from 24 to 30. We consider this group homogeneous in intelligence and age. Among the subjects were nine women. Mandarin Chinese was their native language, even though some of them acquired it as a second dialect. The minimal requirement was that they perform Mandarin tone sandhi correctly and automatically.

Before they came to this country, they had studied English for at least seven years--six years of high-school English and one year of college-freshman English. But most of them learned to speak English after they came to this country. Of course, the degree of English proficiency, as I said before, varied from individual to individual.

The longer one stays in a foreign community, the greater his degree of acculturation. Since language is an essential part of culture, the length of the subjects' stay in this country was felt to be a pertinent factor in this study. Some of our subjects had been in this country for five years; some were newcomers.

DESIGN

Since tone sandhi occurs when two third tones come together, to find out how English stresses are interpreted, we must (A) place a third-tone word before an English word to see if and under what conditions, i.e. preceding what stress, the tone undergoes tone sandhi; and we must (B) place an English word before a Chinese third-tone word, in the position where a Chinese third tone would have undergone tone sandhi, to see if and what kind of stress of the last syllable of the English word changes to the pitch of the Chinese second tone. Thus we constructed the following two types of sentences for the subjects to read:

A. Tā jīntian yǒu dàte.
He has a date today.
Tā xiǎng rélax yí xià.
He wants to relax a while.

B. Méi rén kàn $\overset{3}{\underline{\text{editorial}}}$ bǎn.

Nobody reads the editorial page.

Tā shì wǒmen de $\overset{4}{\underline{\text{department}}}$ zhǔ rèn.

He is our department head.

In order to avoid any artificiality in this experiment, the English words were for the most part taken from sentences in natural speech which I recorded in the fall of 1964. Generally speaking, second stress is not readily acquired: syllables with secondary stress, such as 'Lóng Ísland', were usually pronounced with primary stress. Consequently, in these sentences words beginning with secondary stress were missing.

Seventy-two sentences were constructed by using various words with primary, tertiary, and weakest stresses in crucial positions. Each sentence was written on a 3x5 card in Chinese characters and conventional English orthography. Each card was then classified in terms of types (A or B), stresses, and the number of syllables in the English words. The cards were then randomly ordered and numbered to avoid a "sing-song" pattern. This randomly arranged order was used throughout the entire recording.

To avoid hesitation and deliberation, the subjects were not told the purpose of this experiment before the recording. They were merely asked to read each sentence at normal speed and again at fast speed, as the sentences were tape-recorded.

After the reading, each subject was then told the purpose of this experiment and was asked to express his "feeling" about tone change in both type A and type B.

The subjects were numbered and the numbers were written on each card. If tone sandhi occurred or the English syllable acquired the Chinese rising pitch, no matter at what speed, "+" was assigned to the number of the subject; otherwise "-" was recorded.

RESULTS

A few of the sentences were discarded because the English words were pronounced differently by different subjects (e.g. 'permit$^{4\ 1}$' and 'permit$^{1\ 3}$' in a definite structure--noun). These sentences will not enter into our discussion.

If a third tone has a low pitch, we say it undergoes no phonemic change; only if a third tone changes to a second tone do we consider it tone sandhi. The results are strikingly neat. There was no tone or pitch change in Type-B sentences. Only a Chinese third tone immediately preceding the English weakest stress changed to a second tone. The difference in the speed of utterance is relevant. If a subject spoke too slowly and with a pause between the Chinese and English words, then the condition for tone sandhi disappeared. Usually tone sandhi occurred in the faster reading.

Table 1 (page 12) shows the number of total items and the number of occurrences of tone sandhi in Chinese third-tone words immediately preceding primarily stressed syllables in English words; the latter are grouped into categories of one, two, three, and four (or more) syllables. 15 is the number of subjects; the numbers after 15 are the numbers of words (sentences) and the numbers of total occurrences of the words spoken by the fifteen subjects.

In 240 occurrences, tone sandhi occurred only once before the word 'block'. This might be accidental. On the other hand, since there is no "bl" cluster in Chinese, the subject may have unconsciously inserted a vowel between the "b" and the "l"; in his mind the word was then dissyllabic and had the weakest stress on the first syllable.

In Chinese words preceding English tertiary stress (Table 2, page 13) tone sandhi occurred only once, before the word 'combination'. This might be because the first syllable was felt to have the weakest stress.

As expected, tone sandhi occurred before the weakest stress.

From Table 3 (page 14), we see the importance of the number of syllables in a word. More occurrences of tone sandhi took place before words with fewer syllables, which are more like Chinese monosyllabic words.

Some subjects felt that it was difficult to produce two sounds of low pitch in sequence; therefore, they changed the Chinese third-tone preceding an English weakest syllable to the second tone. Others did not know what had happened.

We first thought that the person who had stayed for a shorter time in this country and hence had less "English domination" would perform tone sandhi more often, since he would be more dominated by his native language--Chinese. To judge from our results, however, this is not the case. We do not see any correlation between tone sandhi and the subject's length of stay in this country.

DISCUSSION

Stress does not exist in the underlying representations of English phonology. But in studying bilingual phenomena, the phonetic level is also important. What the Chinese students have learned are mostly low-level rules.

Fry (1955) found that when a vowel was long and of high intensity, listeners agreed that the vowel was strongly stressed; when it was short and of low intensity, it was judged weakly stressed. The results of his experiments indicate that the duration ratio has a stronger influence on judgments of stress than has the intensity ratio. Lehiste and Peterson (1959) also reported experiments on stress. Their conclusion was that perceptual judgments of linguistically significant stress in English are reflected in at least four acoustical parameters: speech power, fundamental voice frequency, phonetic quality, and duration. In 1960, Lieberman (1960) reported that a stressed syllable had a higher fundamental frequency, a higher peak envelope amplitude and a longer duration than did an unstressed syllable. Of these factors he judged the fundamental frequency most relevant. A simple binary automatic stress recognition program containing pitch, amplitude, duration, and their correlates, was devised. The stress judgments made with this program were reported and show 99.2% agreement with the perceived patterns.

None of these studies looked at the degrees of English stress: primary, secondary, tertiary, and weakest; rather, they all compared the stronger syllable in a word or a phrase with the weaker one.

Summing up, we can say that at least three factors determine the stress differences in English: fundamental frequency, amplitude, and duration. Fundamental frequency is probably the most significant of these for perception, since a stronger passage of air usually makes the vocal cords vibrate faster.

I analyze Mandarin tones (see Cheng [1966]) in terms of the following

three features:

	−	ˊ	ˇ	ˋ
high	+	+	-	+
rising	-	+	+	-
falling	-	-	+	+

There is a redundancy rule in Mandarin:

Redundancy Rule

$$\begin{bmatrix}+\text{high} \\ +\text{rising}\end{bmatrix} \longrightarrow [-\text{falling}]$$

The tone sandhi rule

ˇ ˇ ⟶ ˊ ˇ

can be written as:

$$[-\text{high}] \longrightarrow [+\text{high}] \; / \begin{bmatrix}+\overline{\text{rising}} \\ +\text{falling}\end{bmatrix} \quad \begin{bmatrix}-\text{high} \\ +\text{rising} \\ +\text{falling}\end{bmatrix}$$

However, since there is only one [-high] tone in this language, the third tone can be marked with one feature: [-high]. Furthermore, since the [+high] tones do not undergo tone sandhi before the [-high] tone, the tone-sandhi rule can be formulated as:

Tone Sandhi Rule

$$[\quad] \longrightarrow [+\text{high}] \; / \; \underline{\quad\quad} \; [-\text{high}]$$

English stress, as I said before, has at least three acoustic features: pitch, amplitude, and duration. Pitch is either relatively high or relatively low. Thus we can use [high] for pitch. When the two languages, Chinese and English, come into contact, the only feature in common is [high]. The features [rising] and [falling] are irrelevant in English.

From above results, added to the fact that most Chinese speakers lump secondary stress with primary, we conclude that Chinese speakers assign the values + and - to English stresses in the following way:

Interpretation Rule	English		Chinese
	$\left\{\begin{matrix}1\\2\\3\end{matrix}\right\}$	⟶	[+high] (=[+high])
	4	⟶	[-high] (=[-high])

In order that tone sandhi can occur, the tone sandhi rule must apply after the interpretation rule. For example:

hao	^{4}professor$^{1\ 4}$	⟶ Interpretation Rule ⟶	
$\begin{bmatrix}-\text{high}\\+\text{rising}\\+\text{falling}\end{bmatrix}$			
hao	^{4}professor$^{1\ 4}$	⟶ Tone Sandhi Rule ⟶	
$\begin{bmatrix}-\text{high}\\+\text{rising}\\+\text{falling}\end{bmatrix}$	[-high]		
hao	^{4}professor$^{1\ 4}$	⟶ Redundancy Rule ⟶	
$\begin{bmatrix}+\text{high}\\+\text{rising}\\+\text{falling}\end{bmatrix}$	[-high]		
hao	^{4}professor$^{1\ 4}$		
$\begin{bmatrix}+\text{high}\\+\text{rising}\\-\text{falling}\end{bmatrix}$	[-high]		

In type B, the weakest stress preceding a Chinese third tone could be changed to [+high] by the tone-sandhi rule. But the stresses which are interpreted as [+high] are primary, secondary, and tertiary, and none of these has the feature [rising], since [rising] is not relevant in English. Thus the application of the rules cannot change an English syllable into a Chinese rising tone.

Table 1. Occurrence of tone sandhi in Chinese third-tone words immediately preceding English primary stress in one, two, three, and four-syllable words. (+ indicates occurrence; - indicates nonoccurrence)

one		two		three		four	
15x5=75		15x3=45		15x6=90		15x2=30	
+	-	+	-	+	-	+	-
1	74	0	45	0	90	0	30

Table 2. Occurrence of tone sandhi in Chinese third-tone words preceding English tertiary stress.

four	
15x5=75	
+	-
1	74

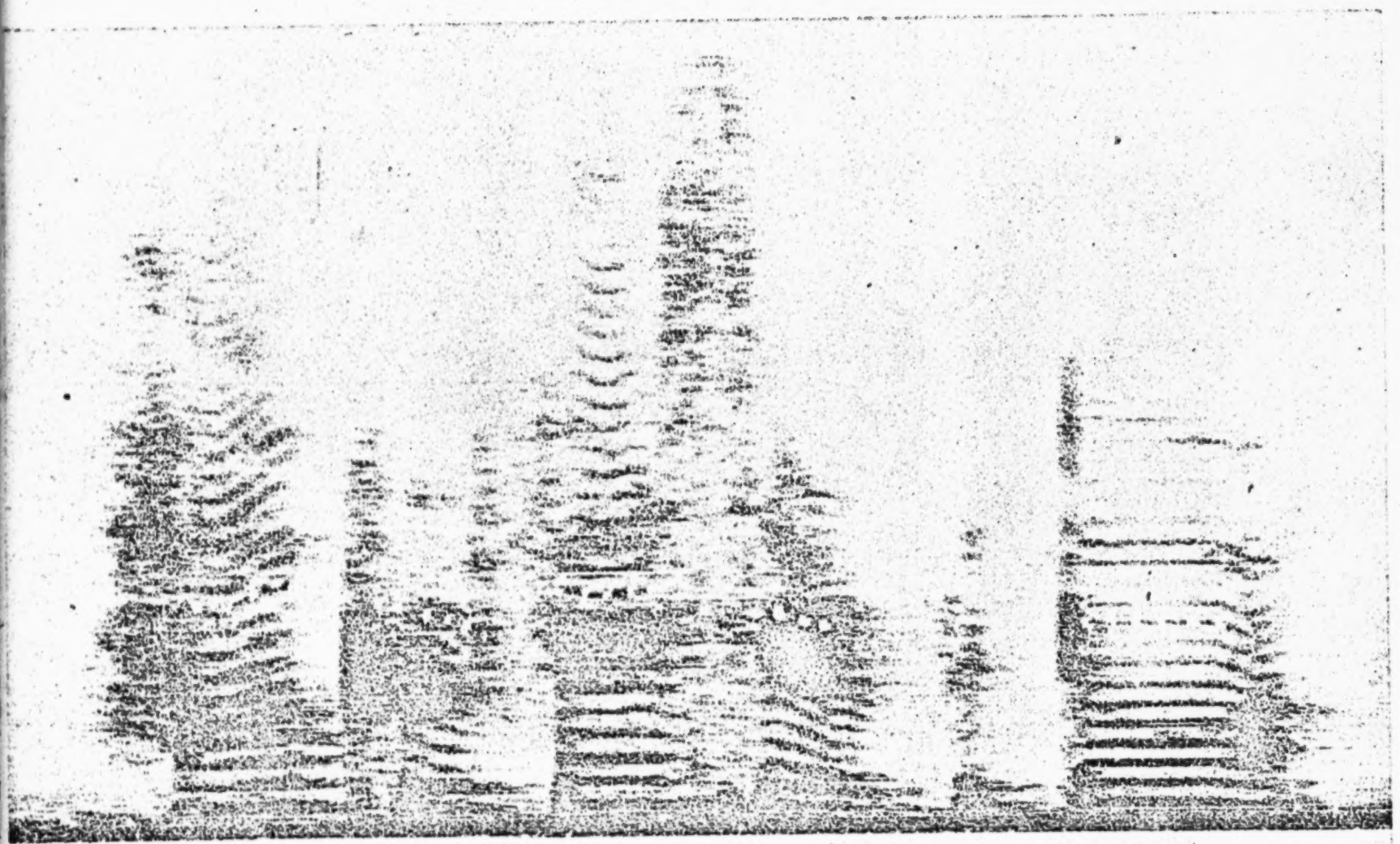
Table 3. Occurrence of tone sandhi in Chinese third-tone words preceding English weakest stress.

two		three		four	
15x9=135		15x10=150		15x8=120	
+	-	+	-	+	-
79	56	70	80	36	84

SUPPLEMENTARY REPORT

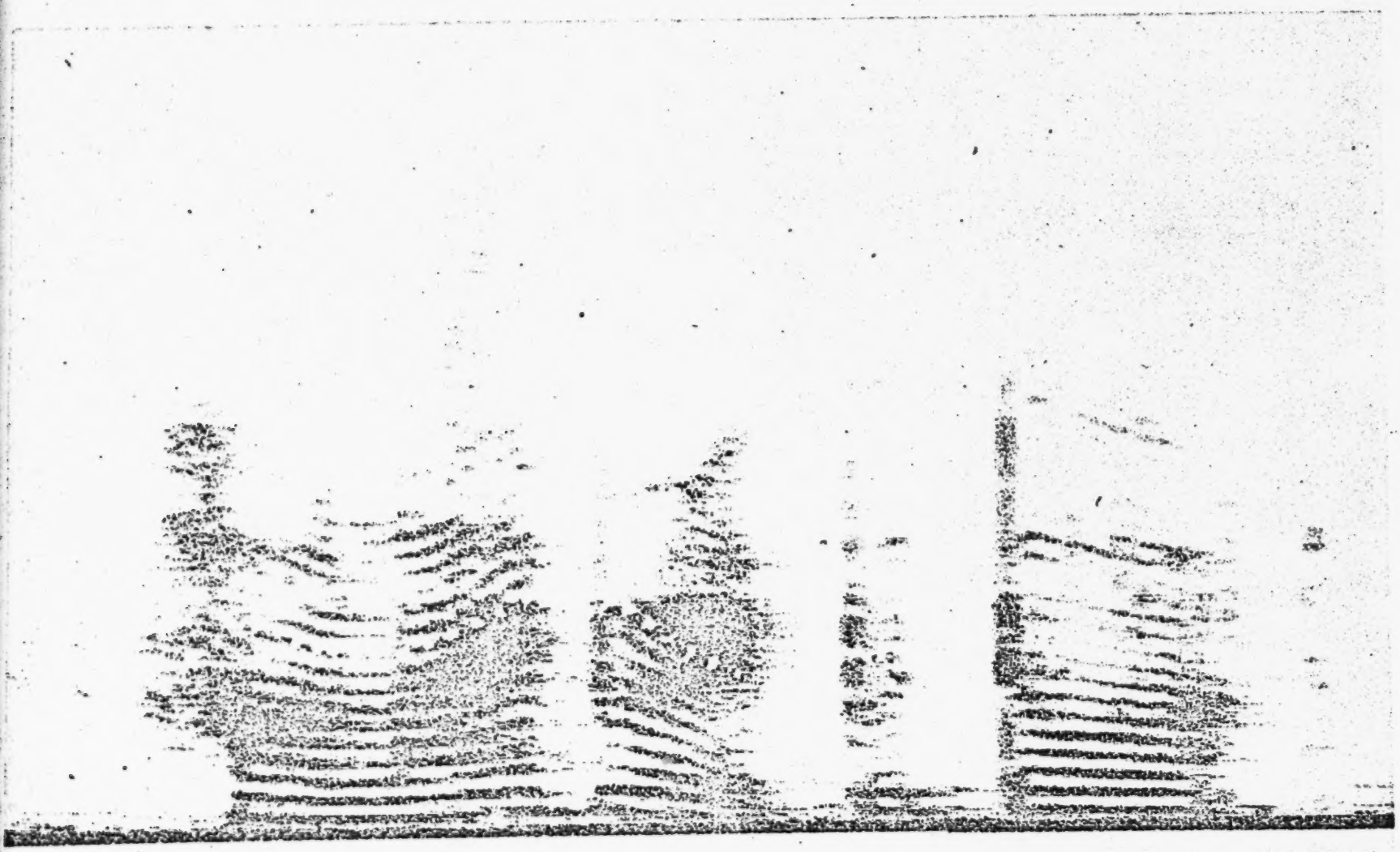
The spectrograms in Figures 1 and 2 show the pitch contours of 'hǎo professor bu duō' ("there are not many good professors") and 'hǎo library bu duō' ("there are not many good libraries"). The third tone of 'hǎo' has changed to a rising pitch before the syllable 'pro', which has the weakest stress; before 'library', which has a primarily stressed syllable at the beginning, it has a low pitch.

Figure 1. Spectrogram of 'hǎo professor bu duō'.



h a o p r o f e ss o r b u d u o

Figure 2. Spectrogram of 'hǎo library bu duō'.



h a o l i b r a r y b u d u o

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